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Original Article

Disparities in cancer-related financial toxicity across economically diverse provinces in China: A multi-center cross-sectional study

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ABSTRACT

Objective: China's diverse economic landscape across its regions may contribute to disparities in cancer-related financial toxicity (FT), but empirical evidence is lacking. This study examined regional disparities in cancer-related FT across economically diverse provinces in China.

Methods: A cross-sectional study was conducted among adult patients with cancer from six tertiary and six secondary hospitals across three Chinese provinces with varying economic statuses (high-, middle-, and low-income). FT was assessed using the COmprehensive Score for financial Toxicity (COST). Hierarchical regression analysis was employed to compare FT among participants from different economic regions, controlling for 13 patient-level sociodemographic and clinical risk factors.

Results: From February to October 2022, 1208 participants completed the survey (response rate = 97.3%). Mean COST scores were 21.99 ± 6.37 (high-income), 20.38 ± 8.01 (middle-income), and 19.20 ± 5.14 (low-income), showing significant differences ($P < 0.001$), with lower scores indicating more severe FT. After adjusting for covariates, regional economic level was significantly associated with FT, with more severe FT in middle- (B: −1.515; 95% CI: −2.250, −0.780) and low-income regions (B: −2.159; 95% CI: −2.899, −1.418) than in high-income regions.

Conclusions: This study reveals significant disparities in cancer-related FT across economically diverse provinces in China. The findings underscore the need for targeted policies and interventions to improve health equity in cancer care, with a focus on not neglecting middle-income regions. Oncology nurses are expected to enhance awareness of FT management, voice the needs of patients, and advocate for policy reforms to address these disparities.

Introduction

Cancer-related financial toxicity (FT) refers to the negative impact of the financial burden associated with cancer care costs on patients and their families.[1] These costs include direct medical expenses, such as those related to hospital care, drugs, tests, and procedures; direct non-medical expenditures, such as those related to additional nutrition, transportation, accommodation, and informal nursing services; and indirect costs, such as the loss of income.[2] Collectively, these expenses pose a challenge to the financial stability of patients, hinder their access to treatment, and impact their overall well-being.[2–5] Moreover, this financial burden can influence patients' broader health outcomes, including quality of life and survival rates.[2–5]

Globally, the problem of cancer-related FT has gained increasing attention within the realm of comprehensive cancer care. Empirical evidence indicates a substantial disparity in the prevalence of cancer-related

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FT between high-income and low- to middle-income countries.[1,6] A meta-analysis demonstrated that the pooled cancer-related FT rate was 35.3% in high-income countries and 78.8% in low- and middle-income countries.[1] Furthermore, another meta-analysis highlighted this distinction, reporting a lower prevalence of FT in high-income countries, such as the United States (39%) and Japan (35%), than in low- and middle-income countries such as China and Tunisia.[6] These findings suggest the critical role of the regional economic level as a factor influencing the observed disparities in cancer-related FT.

In China, which is categorized as a low- and middle-income country, substantial challenges are posed by cancer-related FT. A systematic review demonstrated a broad range of the prevalence of cancer-related FT in China, from 6% to 84%.[2] This variation may be attributable to regional economic disparities. China, characterized by its vast geographical expanse, exhibits a diverse economic landscape across its regions. For example, in 2022, the per capita gross domestic product (GDP) in Beijing, the highest-ranking provincial unit of China, was projected to be four times higher than that in Gansu, the lowest-ranking provincial unit (190, 313 Chinese yuan [approximately US$26,432] vs. 44,968 Chinese yuan [approximately US$6246]).[7]

Although previous studies have identified multifaceted factors influencing cancer-related FT in China, they have predominantly focused on patient demographics, socioeconomic status, and clinical characteristics.[8–18] Notably, limited studies have explored the influence of regional economic levels on cancer-related FT in China. To address this knowledge gap, in this study, we investigated disparities in cancer-related FT across economically diverse provinces in China. Identification of these disparities is crucial for policymakers and advocacy groups to provide a foundation for developing supportive measures that align with the unique needs of patients in various economic landscapes. By offering context-specific insights into cancer-related FT in China, this study contributes to the global discourse on cancer care disparities.

Methods

Study design and setting

We conducted a secondary analysis of data from a project that examined the current status of FT and its mediating role in the relationship between quality of life and its associated risk factors.[19] This project involved a multisite, cross-sectional survey of Chinese patients with cancer. The original study was conducted in the inpatient wards of six tertiary and six secondary hospitals across three economically diverse Chinese provinces (i.e., Jiangsu, Hunan, and Guizhou) from February to October 2022.

Participants

In the original study, 1208 participants completed the survey, resulting in a response rate of 97.3%. The inclusion criteria for participants were as follows: (1) having a diagnosis of cancer at any site and stage, (2) being aged 18 years or older at the time of cancer diagnosis, (3) undergoing active anticancer treatment for at least 2 months[20] (or having completed initial treatment), (4) having the ability to communicate in Mandarin, and (5) being able to comprehend the survey. The exclusion criteria were (1) having multiple primary cancers, (2) receiving hospice care, (3) participating in a clinical trial for treatment, (4) refusing to participate, and (5) having the cancer diagnosis concealed by family members.

In this secondary analysis, we included data from all 1208 participants. This sample size was deemed adequate to examine the association between regional economic levels and FT after controlling for patient-level sociodemographic and clinical covariates through hierarchical regression analysis. The analysis aimed for an effect size as small as $f^2 = 0.009$ with 90% power and a 5% significance level. Power analysis was performed using PASS 16 (NCSS, Kaysville, UT, USA) and expected to efficiently meet the analysis requirements of the present study.

Variables and measures

Dependent variable: FT

FT was measured using the simplified Chinese version of the COmprehensive Score for financial Toxicity (COST),[21] which includes 12 items. Item 12 was used as a screening question and not included in the scoring. The remaining 11 items were rated on a 5-point Likert scale (from 0 to 4), reflecting experiences over the past 7 days. The total COST score ranges from 0 to 44, with lower scores indicating more severe FT. The Chinese version of the COST demonstrated good internal consistency in our study (Cronbach's $\alpha = 0.809$).

Independent variable: regional economic level

For the original study, we used a stratified sampling method to select the provinces. The sampling framework included 27 provinces or equivalent administrative units in Chinese mainland, excluding four regions that are difficult to access (Xinjiang, Tibet, Inner Mongolia, and Qinghai). Initially, these 27 provinces or equivalent administrative units were stratified into three strata based on the 2020 GDP per capita reported by the National Statistical Yearbook.[22] These three groups represented high-, middle-, and low-income levels, respectively, based on GDP per capita. Subsequently, one province or equivalent administrative unit was randomly selected from each strum of income group.

Covariates

We considered 13 patient-level sociodemographic and clinical covariates: age at cancer diagnosis, marital status, annual household income, negative employment changes due to cancer for both patients and their family caregivers, cancer stage, length of hospital stay for cancer or its treatment-related side effects, social and commercial medical insurance, hospital level (tertiary or secondary), discussions between health care providers and patients regarding cancer care costs, perceived stress, and social support. These covariates were identified to be associated with FT in our prior study.[19] In that prior study, we initially analyzed 28 potential risk factors, informed by (1) our systematic review[2] and (2) additional risk factors identified in studies on other populations that could be relevant to the Chinese population.[4,23–25] Finally, 13 of these were identified to be associated with FT.

Discussions between health care providers and patients regarding cancer care costs were assessed by asking participants if any health care provider had discussed out-of-pocket (OOP) costs of cancer care with them.[26] Response options were "discussed in detail", "briefly discussed", "did not discuss", or "I don't remember". Participants who answered "discussed in detail" were categorized as having an adequate discussion, whereas all other responses indicated an inadequate discussion.[26]

Perceived stress was assessed using the simplified Chinese version of the Perceived Stress Scale (CPSS),[27] which comprises 14 items that evaluate the perception of life as unpredictable, unmanageable, or stressful over the past month. Responses are rated on a five-point Likert scale (from 0 to 4), with total scores ranging from 0 to 56. Higher scores indicate increased perceived stress. The CPSS demonstrated good internal consistency in our study (Cronbach's $\alpha = 0.911$).

Social support was assessed using the simplified Chinese version of the Medical Outcomes Study Social Support Survey (MOS–SSS–C),[28] which includes 19 items evaluating the support received since the participants' cancer diagnosis. Items are rated on a five-point Likert scale (from 1 to 5). The total score of the MOS–SSS–C was computed by averaging the item scores and then was converted using the formula: converted score = (observed score − minimum possible score)/(maximum possible score − minimum possible score) × 100. The total score ranges from 0 to 100, with higher scores indicating increased support. The MOS–SSS–C demonstrated good internal consistency in our study (Cronbach's $\alpha = 0.953$).

The level of hospital where participants were recruited was recorded by the data collectors, and other covariates were collected from the participants using a self-designed questionnaire.

Data collection

Before data collection for the original study, approval and support were obtained from the nursing department stakeholders in the selected hospitals. Participant recruitment was conducted with the assistance of trained head or responsible nurses at each hospital. The survey was administered using a face-to-face approach by the Principal Investigator and trained data collectors. During these in-person interactions, participants completed an electronic questionnaire. The details of the data collection procedure is presented in Fig. 1.

Data analysis

All data analyses were conducted using IBM SPSS 28.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using skewness and kurtosis statistics, with absolute values ≤ 2 and ≤ 7,

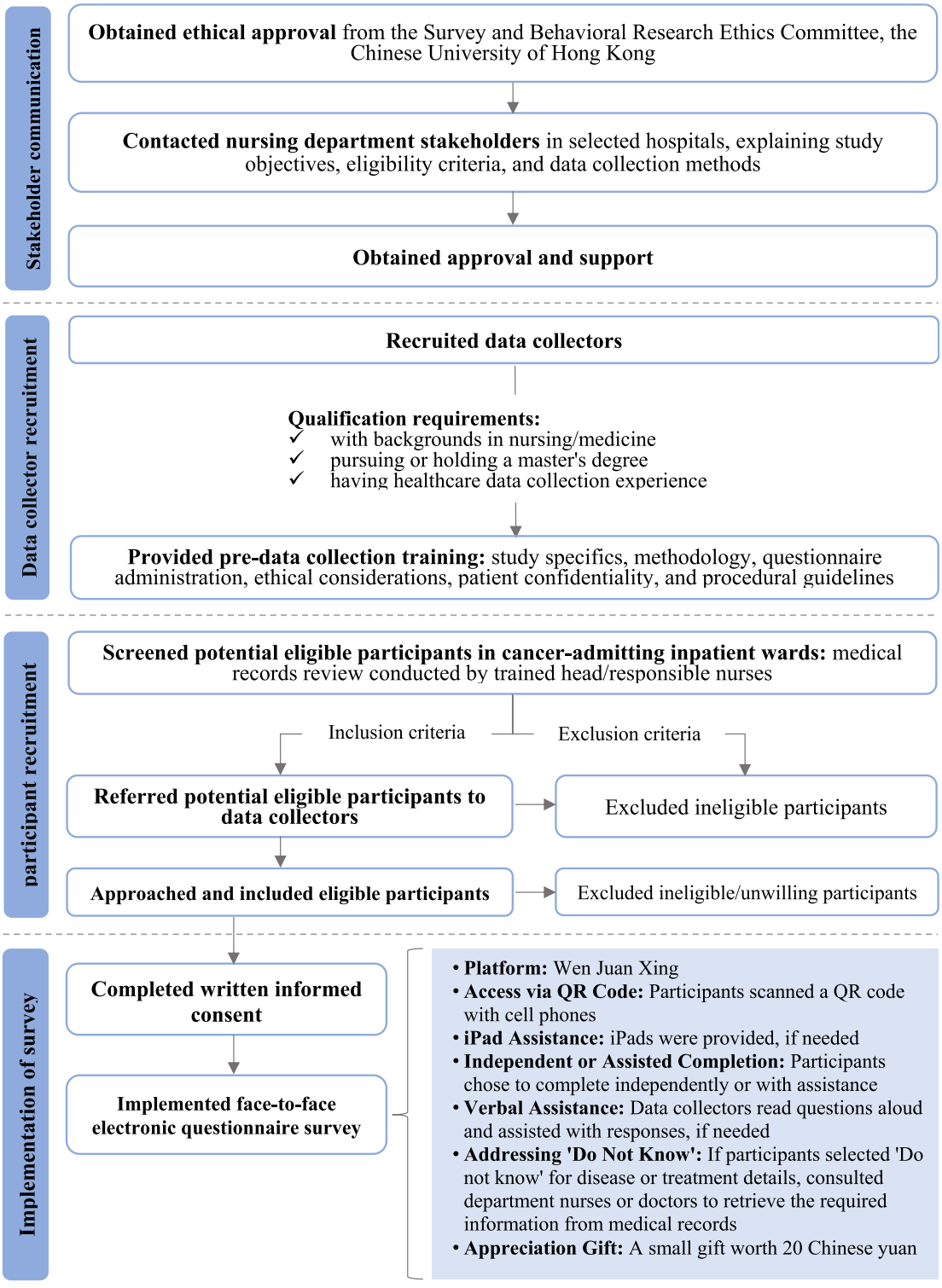

Fig. 1. Detailed data collection process.

Table 1
Participants' characteristics and stratified by region economic level ($N = 1208$).

Characteristics	Overall ($n = 1208$)	High-income ($n = 408$)	Middle-income ($n = 400$)	Low-income ($n = 400$)
	n (%)	*n* (%)	*n* (%)	*n* (%)
Age at cancer diagnosis (years) [Mean ± SD]	53.53 ± 11.74	54.62 ± 12.00	52.98 ± 12.09	52.98 ± 11.06
Marital status				
Married	1093 (90.5)	376 (92.2)	351 (87.8)	366 (91.5)
Single/Divorced/Widowed	115 (9.5)	32 (7.8)	49 (12.3)	34 (8.5)
Annual household income (Chinese yuan)				
≤ 70,000	646 (53.5)	213 (52.2)	201 (50.3)	232 (58.0)
> 70,000	562 (46.5)	195 (47.8)	199 (49.8)	168 (42.0)
The influence of cancer on patients' work				
No	386 (32.0)	143 (35.0)	128 (32.0)	115 (28.8)
Yes	822 (68.0)	265 (65.0)	272 (68.0)	285 (71.3)
The influence of cancer on caregivers' work				
No	452 (37.4)	155 (38.0)	135 (33.8)	162 (40.5)
Yes	756 (62.6)	253 (62.0)	265 (66.3)	238 (59.5)
Cancer stage				
I/II/III	564 (46.7)	207 (50.7)	150 (37.5)	207 (51.8)
IV	613 (50.7)	194 (47.5)	234 (58.5)	185 (46.3)
Unknown	31 (2.6)	7 (1.7)	16 (4.0)	8 (2.0)
Length of hospital stay for cancer treatment or treatment-related side effects (days)				
≤ 65	626 (51.8)	218 (53.4)	198 (49.5)	210 (52.5)
> 65	582 (48.2)	190 (46.6)	202 (50.5)	190 (47.5)
Social medical insurance				
No social medical insurance/Urban and rural resident basic medical insurance	699 (57.9)[a]	192 (47.1)[b]	232 (58.0)[c]	275 (68.8)[d]
Urban employee basic medical insurance	509 (42.1)	216 (52.9)	168 (42.0)	125 (31.3)
Commercial medical insurance				
No	1035 (85.7)	340 (83.3)	322 (80.5)	373 (93.3)
Yes	173 (14.3)	68 (16.7)	78 (19.5)	27 (6.8)
Hospital level				
Tertiary hospital	1008 (83.4)	340 (83.3)	334 (83.5)	334 (83.5)
Secondary hospital	200 (16.6)	68 (16.7)	66 (16.5)	66 (16.5)
Adequate cost discussions with health care providers				
No	763 (63.2)	266 (65.2)	256 (64.0)	241 (60.3)
Yes	445 (36.8)	142 (34.8)	144 (36.0)	159 (39.8)
Perceived stress (range 0–56) [Mean ± SD]	25.75 ± 8.78	26.78 ± 9.28	24.78 ± 9.50	25.66 ± 7.27
Social support (range 0–100) [Mean ± SD]	64.56 ± 14.37	65.56 ± 18.70	64.70 ± 11.75	63.38 ± 11.29

SD, Standard deviation.
[a] Among the 699 participants in this group, 7 did not have social medical insurance.
[b] Among the 192 participants in this group, 3 did not have social medical insurance.
[c] Among the 232 participants in this group, 3 did not have social medical insurance.
[d] Among the 275 participants in this group, 1 did not have social medical insurance.

respectively, considered acceptable.[29] No continuous variables deviated from normal distribution. Categorical data are presented as frequencies and percentages, and continuous variables are presented as means and standard deviations (SDs).

The mean score of COST among the participants across economically diverse regions was compared using one-way analysis of variance. An adjusted comparison of the FT mean score across the three regional economic levels was conducted using a hierarchical regression analysis. All the 13 covariates were included in the first model, and the regional economic level was then added. The unstandardized regression coefficient (B) and its 95% confidence intervals (CI), R^2, R^2, *F* change, and the *P* value of *F* change are presented. A significant *F* change indicates that the regional economic level significantly contributes to explaining the variability of the FT score beyond the patient-level sociodemographic and clinical risk factors for FT. All tests were two-sided, with the significance level set at 0.05.

Ethical considerations

The original study was approval by the Survey and Behavioral Research Ethics Committee, the Chinese University of Hong Kong (IRB No. SBRE-21-0403), and written informed consent was obtained from all participants.

Results

Participant characteristics

Table 1 summarizes participants' characteristics. Among the 1208 individuals from high-income (GDP per capita in 2020: 121,231 Chinese yuan or approximately US$16,838, $n = 408$), middle-income (GDP per capita in 2020: 62,900 Chinese yuan or approximately US$8,736, $n = 400$), and low-income (GDP per capita in 2020: 46,267 Chinese yuan or approximately US$6426), $n = 400$) regions, the mean age at cancer diagnosis was 53.53 (SD = 11.74) years. The majority of the participants were married (90.5%), with over half (53.5%) reporting an annual household income of ≤ 70,000 Chinese yuan (~US$9722). After cancer diagnosis, 68.0% experienced changes in employment and 62.6% noted an impact on family members' employment. Approximately half were diagnosed with advanced cancer (50.7%) and had hospital stays of ≤ 65 days for cancer treatment or related side effects days (51.8%). Almost all the participants had social medical insurance (99.4%), but only 14.3% had commercial medical insurance. The ratio of participants recruited from tertiary to secondary hospitals was 5:1. Furthermore, 36.8% reported having adequate discussions regarding costs with health care providers. The mean scores for perceived stress and social support were 25.75 ± 8.78 and 64.56 ± 14.37, respectively.

Table 2
Comparison of COST score among patients with cancer across economically diverse regions ($N = 1208$).

Regional economic level	COST score Mean (SD)	*F*	*P*-value
High	21.99 (6.37)	18.216	< 0.001
Middle	20.38 (8.01)		
Low	19.20 (5.14)		

COST, The Comprehensive Score for financial Toxicity.

Table 3
Hierarchical regression analyses of financial toxicity among patients with cancer ($N = 1208$).

	B (95% CI)	R^2	R^2 change	*F* change	*P*-value of *F* change
Model 0[a]	–	0.391	–	–	–
Model 1[b]	–	0.408	0.017	17.334	< 0.001
Regional economic level	–	–	–	–	–
High	Reference	–	–	–	–
Middle	−1.515 (−2.250, −0.780)	–	–	–	–
Low	−2.159 (−2.899, −1.418)	–	–	–	–

- Not applicable.
B, unstandardized regression coefficient; CI, Confidence Interval.
[a] Model 0 includes 13 socio-demographic and clinical covariates, as listed in Table 1.
[b] Model 1 incorporates the 13 covariates from Model 0 and additionally considers the Regional Economic Level.

COST scores

The mean score of COST of the participants from high-income, middle-income, and low-income regions were 21.99 ± 6.37, 20.38 ± 8.01, and 19.20 ± 5.14, respectively. The difference in the mean score of COST across three economically diverse regions was statistically significant ($P < 0.001$, Table 2).

Association between regional economic level and FT

Table 3 presents the results of hierarchical regression analysis. After including the patient-level sociodemographic and clinical risk factors for FT, further inclusion of the regional economic level into the model resulted in a 1.7% change in R^2 and an *F* change of 17.334 ($P < 0.001$). The final model revealed that the participants from the middle-income region (B: −1.515; 95% CI: −2.250, −0.780) or low-income region (B: −2.159; 95% CI: −2.899, −1.418) had lower COST scores than those from the high-income region, indicating more severe FT in the middle- and low-income regions than in the high-income region.

Discussion

Discussion of this study

Our study demonstrated a substantial disparity in cancer-related FT across economically diverse provinces in China, as indicated by the significant differences in COST scores. In particular, the participants from middle- and low-income regions had significantly lower COST scores than their high-income counterparts, indicating a more severe cancer-related FT in economically disadvantaged provinces. This observed disparity is consistent with global research trends,[1,6] highlighting the pivotal effect of regional economic levels on FT experienced by individuals undergoing cancer treatment.

The observed disparity in cancer-related FT across economically diverse provinces warrants further investigation into its underlying determinants. Variations in regional economic levels often reflect the personal or family income of patients. Patients residing in areas with lower economic levels typically encounter challenges in accumulating wealth, making it inherently more difficult for them to navigate financial pressure associated with a cancer diagnosis and subsequent treatment. While personal or family income is a critical determinant of financial resilience, we rigorously controlled for this variable. Thus, the observed differences may stem from other factors, particularly those at the policy level.

The landscape of medical insurance policies may contribute to the observed differences in cancer-related FT. Despite the presence of a national basic medical insurance system in China, variations in policies across regions exist due to the autonomy of local governments in managing insurance funds and formulating policies, resulting in uneven benefit packages.[30,31] For instance, regions may modify the reimbursement rates of medical insurance or provide additional medical coverage depending on their economic status and the balance of medical insurance funds.[32] These adjustments can lead to differences in patient OOP costs and subsequent FT.

Individual OOP health expenditure in China accounted for 27.7% of total health expenses in 2020.[33] In our study, the share of OOP expenditures for high-, middle-, and low-income provinces were 23.9%, 29.4%, and 24.0%, respectively.[33] The middle-income province had a significantly higher share of OOP health expenditure than the high-income province. This disparity in the share of OOP expenditure might explain why cancer-related FT was more severe in middle-income regions than in high-income regions. Although FT was more severe in low-income regions, OOP expenditure proportions did not substantially differ between low- and high-income regions. Parity in the share of OOP expenditure may result from higher government subsidies in low-income regions.[34] In 2020, government health expenditure in low- and high-income provinces accounted for 41.3% and 23.1% of the total health expenditure, respectively.[33] This finding highlights the critical role of government interventions in mitigating the financial burden associated with cancer care, particularly in regions with less economic resources. However, because the measurement of cancer-related FT in our study was based on patient-reported outcomes, despite similar share of OOP expenditure between low- and high-income regions, the overall lower economic status of patients in low-income regions may amplify the financial pressure exerted by the same OOP expenditure rates, contributing to more severe cancer-related FT.

Implications for nursing practice and research

In China, health care funding comes from various channels, including central and local government health expenditures, societal investment in health services, and individuals OOP expenses.[35] Economically developed regions rely more on social expenditures due to established social infrastructure and private sector involvement, whereas less affluent regions rely heavily on government funding due to their limited resources.

In recent years, the Chinese government has prioritized health equity. The government launched the “Healthy China 2030” plan in 2016, aiming to reduce the proportion of OOP health expenses in the total health expenditure to 25% by 2030.[36] To achieve this target, the government is directing health expenditure toward economically disadvantaged regions.[31] To the best of our knowledge, this study is the first to demonstrate the need for corresponding support in middle-income regions, which may be overlooked. Immediate measures are necessary to address the severe cancer-related FT in low- and middle-income regions.

Recommendations include optimizing subsidies from the central government to promote balance and equity in the allocation of health resources across regions. Authorities in low- and middle-income regions should strengthen local economic growth and financial planning to provide sufficient funds for cancer care. In addition, policymakers should introduce policies to minimize disparities in regional medical insurance policies and balance reimbursement levels for residents across different regions.

Oncology nurses are pivotal in mitigating cancer-related FT and promoting health equity in cancer care. They are expected to thoroughly understand the prevalence and impact of cancer-related FT, and to enhance their awareness of FT management. In clinical practice, it is crucial to effectively integrate FT screening into routine patient assessments to identify those at risk of FT early. Furthermore, as patient advocates, oncology nurses can broaden their impact beyond direct clinical care. They are anticipated to voice the needs of cancer patients and to advocate for policy reforms to minimize the disparities in cancer-related FT across economically diverse regions.

Limitations

While our study provides valuable insights into the disparities in cancer-related FT across economically diverse regions, several limitations warrant consideration. First, despite controlling patient-level sociodemographic and clinical risk factors, the observed regional disparity in FT might be confounded by some other unobserved or unknown factors, as indicated by the relatively small percentage of variability explained ($R^2 = 0.41$). Second, although we examined the potential influence of policy factors on cancer-related FT, a more in-depth exploration of specific policy mechanisms and their impact on FT was outside the scope of this study. Future studies should delve deeper into the policy landscape. Finally, while our findings may be applicable to other countries with similarly diverse economic landscapes, the unique characteristics of each country's health care system, cultural context, and economic structure necessitate context-specific validations.

Conclusions

This study reveals a significant disparity in cancer-related FT across economically diverse provinces in China, with participants from middle- and low-income regions experiencing more severe FT than their high-income counterparts. Our findings emphasize the urgent need for increased awareness and targeted intervention from governments, policymakers, and health care providers to address this discrepancy. Targeted initiatives and policies are essential to ensure equitable access to quality care across diverse economic strata in China. Oncology nurses are expected to enhance their awareness of FT management, voice the needs of patients, and advocate for policy reforms to minimize disparities in cancer-related FT across economically diverse regions. Furthermore, these findings may extend beyond China, suggesting potential global relevance. Countries with similar economic landscapes may encounter similar disparities, indicating the need for context-specific validations and global strategies to mitigate cancer-related FT and promote health equity.

CRediT authorship contribution statement

Binbin Xu: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Project administration. **Winnie K. W. So**: Conceptualization, Methodology, Validation, Writing – review & editing, Supervision. **Kai Chow Choi**: Conceptualization, Methodology, Validation, Formal analysis, Writing – review & editing. **Yu Huang, Mei Liu, Lanxiang Qiu, Jianghong Tan, Hua Tao, Keli Yan & Fei Yang**: Resources, Writing – review & editing. All authors have read and approved the final version of the article, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Ethics statement

The study was approval by the Survey and Behavioral Research Ethics Committee, the Chinese University of Hong Kong (IRB No. SBRE-21-0403), and written informed consent was obtained from all participants.

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Declaration of competing interest

All authors have no conflicts of interest to declare. The two authors, Professor Winnie K.W. So, and Dr. Kai Chow Choi, serve as the editorial board members of the *Asia–Pacific Journal of Oncology Nursing*. The article underwent the standard review procedures of the journal, with the peer review process managed independently from Professor So and their research groups.

Data availability statement

The data that support the findings of this study are available on reasonable request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declaration of generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

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